1. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 8x^3 - 34x^2 - 39x + 45$$

A. $z_1 \in [-5.9, -3.5]$, $z_2 \in [-1.82, -1.31]$, and $z_3 \in [0.6, 0.73]$

B. $z_1 \in [-1, -0.1]$, $z_2 \in [0.87, 1.6]$, and $z_3 \in [4.82, 5.23]$

C. $z_1 \in [-2.7, -0.7]$, $z_2 \in [-0.01, 1.07]$, and $z_3 \in [4.82, 5.23]$

D. $z_1 \in [-5.9, -3.5]$, $z_2 \in [-1.01, -0.49]$, and $z_3 \in [1.5, 1.58]$

E. $z_1 \in [-5.9, -3.5]$, $z_2 \in [-3.25, -2.68]$, and $z_3 \in [0.18, 0.44]$

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2. What are the *possible Integer* roots of the polynomial below?

$$f(x) = 4x^3 + 4x^2 + 5x + 5$$

A. $\pm 1, \pm 2, \pm 4$

B. All combinations of: $\dfrac{\pm 1, \pm 5}{\pm 1, \pm 2, \pm 4}$

C. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 5}$

D. $\pm 1, \pm 5$

E. There is no formula or theorem that tells us all possible Integer roots.

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3. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 9x^3 + 27x^2 - 82x + 40$$

A. $z_1 \in [-5.3, -4.79]$, $z_2 \in [0.74, 0.79]$, and $z_3 \in [1.47, 1.57]$

B. $z_1 \in [-1.7, -1.42]$, $z_2 \in [-0.8, -0.68]$, and $z_3 \in [4.86, 5.23]$

C. $z_1 \in [-1.36, -0.85]$, $z_2 \in [-0.67, -0.56]$, and $z_3 \in [4.86, 5.23]$

D. $z_1 \in [-4.43, -3.76]$, $z_2 \in [-0.38, -0.13]$, and $z_3 \in [4.86, 5.23]$

E. $z_1 \in [-5.3, -4.79]$, $z_2 \in [0.65, 0.68]$, and $z_3 \in [1.07, 1.37]$

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4. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{25x^3 - 105x^2 + 83}{x - 4}$$

A. $a \in [95, 103], b \in [-507, -499], c \in [2020, 2024]$, and $r \in [-8000, -7994]$.

B. $a \in [22, 30], b \in [-9, -4], c \in [-20, -19]$, and $r \in [2, 8]$.

C. $a \in [22, 30], b \in [-30, -28], c \in [-96, -87]$, and $r \in [-189, -184]$.

D. $a \in [22, 30], b \in [-207, -201], c \in [817, 822]$, and $r \in [-3198, -3194]$.

E. $a \in [95, 103], b \in [292, 297], c \in [1179, 1182]$, and $r \in [4802, 4808]$.

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5. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{10x^3 + 41x^2 + 51x + 22}{x + 2}$$

A. $a \in [-22, -19]$, $b \in [79, 86]$, $c \in [-112, -106]$, and $r \in [241, 249]$.

B. $a \in [9, 13]$, $b \in [17, 23]$, $c \in [6, 10]$, and $r \in [-1, 9]$.

C. $a \in [9, 13]$, $b \in [9, 15]$, $c \in [16, 27]$, and $r \in [-36, -29]$.

D. $a \in [9, 13]$, $b \in [57, 66]$, $c \in [173, 175]$, and $r \in [362, 369]$.

E. $a \in [-22, -19]$, $b \in [0, 7]$, $c \in [52, 56]$, and $r \in [126, 134]$.

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6. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{8x^3 - 24x + 14}{x + 2}$$

A. $a \in [6, 14], b \in [-28, -20], c \in [45, 53],$ and $r \in [-132, -124]$.

B. $a \in [-24, -15], b \in [28, 35], c \in [-88, -87],$ and $r \in [182, 199]$.

C. $a \in [6, 14], b \in [-19, -14], c \in [1, 14],$ and $r \in [-4, 0]$.

D. $a \in [6, 14], b \in [16, 23], c \in [1, 14],$ and $r \in [30, 36]$.

E. $a \in [-24, -15], b \in [-36, -28], c \in [-88, -87],$ and $r \in [-166, -160]$.

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7. Factor the polynomial below completely, knowing that $x - 5$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^4 - 47x^3 - 102x^2 + 155x + 150$$

A. $z_1 \in [-2, -1],\ z_2 \in [-1.51, -1.18], z_3 \in [0.49, 0.63],$ and $z_4 \in [4.6, 5.8]$

B. $z_1 \in [-2, -1],\ z_2 \in [-0.78, -0.61], z_3 \in [1.5, 1.69],$ and $z_4 \in [4.6, 5.8]$

C. $z_1 \in [-7, -3],\ z_2 \in [-0.65, -0.53], z_3 \in [1.28, 1.5],$ and $z_4 \in [1, 2.4]$

D. $z_1 \in [-7, -3],\ z_2 \in [-0.47, -0.33], z_3 \in [1.9, 2.12],$ and $z_4 \in [2.9, 3.6]$

E. $z_1 \in [-7, -3],\ z_2 \in [-1.68, -1.5], z_3 \in [0.69, 0.99],$ and $z_4 \in [1, 2.4]$

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8. Factor the polynomial below completely, knowing that $x + 4$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 10x^4 + x^3 - 133x^2 + 122x + 120$$

A. $z_1 \in [-3.44, -2.2],\ z_2 \in [-2.14, -1.9], z_3 \in [0.55, 0.83],$ and $z_4 \in [3.48, 4.06]$

B. $z_1 \in [-2.11, -1.78],\ z_2 \in [-0.44, -0.24], z_3 \in [1.31, 1.72],$ and $z_4 \in [3.48, 4.06]$

C. $z_1 \in [-2.11, -1.78],\ z_2 \in [-0.56, -0.46], z_3 \in [2.94, 3.09],$ and $z_4 \in [3.48, 4.06]$

D. $z_1 \in [-4.38, -3.92]$, $z_2 \in [-0.61, -0.56]$, $z_3 \in [1.78, 2.09]$, and $z_4 \in [2.27, 3.18]$

E. $z_1 \in [-4.38, -3.92]$, $z_2 \in [-1.79, -1.59]$, $z_3 \in [0.23, 0.47]$, and $z_4 \in [1.69, 2.08]$

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9. What are the *possible Integer* roots of the polynomial below?

$$f(x) = 5x^3 + 4x^2 + 4x + 2$$

A. All combinations of: $\dfrac{\pm 1, \pm 2}{\pm 1, \pm 5}$

B. $\pm 1, \pm 2$

C. All combinations of: $\dfrac{\pm 1, \pm 5}{\pm 1, \pm 2}$

D. $\pm 1, \pm 5$

E. There is no formula or theorem that tells us all possible Integer roots.

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10. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{6x^3 + 5x^2 - 49x - 55}{x - 3}$$

A. $a \in [18, 20]$, $b \in [57, 63]$, $c \in [126, 132]$, and $r \in [328, 334]$.

B. $a \in [18, 20]$, $b \in [-51, -44]$, $c \in [95, 102]$, and $r \in [-349, -348]$.

C. $a \in [6, 14]$, $b \in [-13, -12]$, $c \in [-13, -8]$, and $r \in [-29, -20]$.

D. $a \in [6, 14]$, $b \in [13, 20]$, $c \in [-17, -14]$, and $r \in [-86, -83]$.

E. $a \in [6, 14]$, $b \in [21, 24]$, $c \in [20, 23]$, and $r \in [2, 10]$.
